# PATENT ABSTRACTS OF JAPAN

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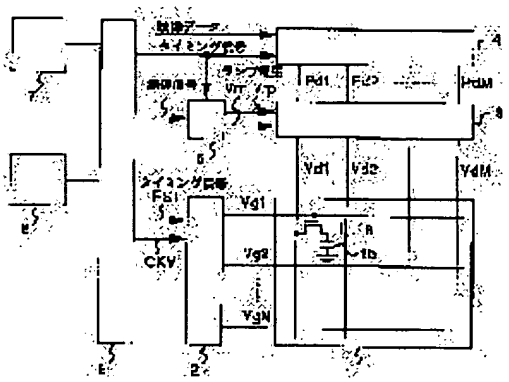
## (54) MULTIGRADATION LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PURPOSE: To provide a multigradation display which displays high-quality image by easily correcting the fluctuation in the threshold value and satd. voltage of a liquid crystal element by variation of production or temp. when such fluctuation arises.




CONSTITUTION: The display device is constituted of a liquid crystal panel 1, a scanning circuit 2, a sampling circuit 3, a sampling control circuit 4, a ramp voltage generating circuit 5, a control circuit 6, a frame memory 7 and a video circuit 8. The liquid crystal panel 1 is constituted of two-dimensionally disposed transistors 1a and liquid crystals 1b. The voltage to be impressed to the liquid crystals 1b is generated by sampling the output of the ramp voltage generating circuit 5 by the sampling circuit 3. The ramp wave generating circuit 5 is inputted with a timing signal and a control signal and outputs the ramp voltages VRP, VRN of both positive and negative polarities. The timing signals are the final signals of the timing for starting and ending the ramp voltages and the control signals are the final signals for controlling the initial voltage and ramp of the ramp signals.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the display which controls brightness by amplitude value of an electrical potential difference, especially relates to the suitable multi-tone liquid crystal display for the liquid crystal display of an active matrix.
[0002]
[Description of the Prior Art] In the display of the AKUITEBU matrix method which carries out the laminating of a switching element and the liquid crystal device, and displays an image, equipment is indicated by 322 pages (SID84DIGEST, 1984pp 319-322) conventionally which performs a multi-tone display from JP,1-92797,A (Fig. 1), JP,2-264294,A (Fig. 1), JP,2-264295,A (Fig. 1) and an S eye day, 90, and 319 pages (1990) of digests. These equipments are the pulse signals which changed the picture signal into the signal of pulse width or phase contrast, sample the reference sign from which an electrical potential difference changes with time amount, and are impressing this electrical potential difference to a liquid crystal device. this approach -- the first half -- the time resolution of a pulse signal, and the first half -- the electrical potential difference of a reference sign -- since the voltage level which impresses resolving power to liquid crystal by making it high can be made [ many ], it is suitable for a multi-tone display.
[0003] On the other hand, while the brightness-voltage characteristic (B-V property) of a liquid crystal device is [ / threshold voltage VTH and near the saturation voltage VSAT ] nonlinear, threshold voltage VTH and saturation voltage VSAT are changed with manufacture dispersion and ambient temperature. Furthermore, the electrical potential difference impressed to liquid crystal is decreased by wiring resistance in a display panel. Since the brightness of the image displayed by such cause is changed, a limitation is in the gradation which can be displayed only by making [ many ] the voltage level only impressed to liquid crystal.
[0004]
[Problem(s) to be Solved by the Invention] As mentioned above, even if it made [ many ] the voltage level impressed to liquid crystal, with the conventional multi-tone indicating equipment, the problem was in the image displayed by fluctuation of the liquid crystal device property by temperature, or wiring resistance in a display panel at the point which brightness unevenness and a color gap produce.
[0005] This invention is made in view of such the present condition, and the purpose solves the above-mentioned problem and is to offer the optimal multi-tone display for displaying the image of high quality without brightness unevenness or a color gap.
[0006]
[Means for Solving the Problem] The display panel with which the multi-tone indicating equipment of this invention carried out the laminating of a switching element and the display object with which brightness is controlled by amplitude value of applied voltage, Digital one and a time amount conversion means to change a digital signal including the information on the brightness to display into a time amount signal, While providing a reference signal generation means to generate the electrical potential difference which changes synchronizing with a time amount signal, and the time amount and the electrical-potential-difference conversion means of generating the signal level which samples the above-mentioned reference sign according to the above-mentioned time amount signal, and is impressed

to the above-mentioned switching element The above-mentioned purpose is attained by lamp voltage generating means to provide a means to control the initial voltage and the inclination of lamp voltage for the above-mentioned reference signal generation means.

[0007] Furthermore, the multi-tone display of this invention can also equip the above-mentioned lamp voltage generating means with the circuit means which the relation between time amount and an electrical potential difference makes two or more polygonal lines.

[0008]

[Function] A lamp voltage generating means inputs a control signal, and can control the initial voltage and the inclination of lamp voltage according to the property and scan condition of a liquid crystal device.

[0009] Consequently, while being able to amend easily manufacture dispersion of the threshold voltage of a liquid crystal device, and saturation voltage, and fluctuation by temperature, since the voltage drop by the wiring resistance in a display panel can also be amended, the multi-tone image of high quality can be displayed.

[0010]

[Example] Hereafter, the example of this invention is explained to a detail. Drawing 1 shows the liquid crystal display of this invention. This liquid crystal display consists of a liquid crystal panel 1, a scanning circuit 2, a sampling circuit 3, the sampling control circuit 4, the lamp generating circuit 5, a control circuit 6, a frame memory 7, and a video circuit 8.

[0011] A liquid crystal panel 1 arranges much transistor 1a and liquid crystal device 1b to two-dimensional, the luminance-signal electrical potential differences Vd1-VdM are connected to the drain of this transistor 1a, and the scan signals Vg1-VgN are connected to the gate.

[0012] The lamp wave generating circuit 5 inputs a timing signal and a control signal, and outputs the lamp voltage VRP and VRN of positive/negative amphipathy. This timing signal is a signal of the last electrical potential difference, in order that initiation of lamp voltage and the control signal of termination timing may control the initial voltage and the inclination of a ramp signal.

[0013] The sampling control circuit 4 inputs the image data and the timing signal which define the brightness of liquid crystal device 1a, and outputs the time amount signals Pd1-PdM. This time amount signal is a signal with which pulse width changes in proportion to image data.

[0014] A sampling circuit 3 inputs this time amount signals Pd1-PdM and lamp voltage, and outputs luminance signals Vd1-VdM.

[0015] A scanning circuit 2 inputs a timing signal and outputs said scan signals Vg1-VgN. A control circuit 6 inputs a frame memory 7 and the signal from a video circuit 8, and outputs the image data of said sampling control circuit, a timing signal, the control signal of a lamp generating circuit, and the timing signal of a scanning circuit.

[0016] The timing chart which shows actuation of the liquid crystal display of this invention constituted as mentioned above to drawing 2 explains.

[0017] FST and CKV which are the timing signal of a scanning circuit 2 are a signal which shows the head of a frame, and the head of a scan line, respectively. The scan signals Vg1-VgN are signals with the pulse width of one period of CKV, and after FST is inputted, the sequential output of them is carried out. The train of each pixel of a display panel is chosen by this scan signal.

[0018] Each inclination is forward and negative and lamp voltage Vrp and Vrn synchronizes with a timing signal CKV. The initial voltage Vrp1 and Vrn1 and the last electrical potential differences Vrp2 and Vrn2 of such lamp voltage are controlled by the control circuit 6.

[0019] The time amount signals Pd1-PdM are signals which changed into pulse width the video signal of each line chosen by the gate scan signal in the sampling control circuit, it starts, timing is equal to the scan signals Vg1-VgN, and pulse width TW1-TWN is proportional to the amplitude value of a video signal.

[0020] By these time amount signals Pd1-PdM, the luminance signals Vd1-VdM which are the outputs of a sampling circuit sampled the lamp voltage of Vrp or Vrn, and are generated. In the example of drawing 2 , the 1st frame is performing [ straight polarity and the 2nd frame ] the switch of lamp voltage Vrp and Vrn for every frame like negative polarity.

[0021] Forward [ this ] and the electrical potential difference Vsp which samples the lamp voltage of negative polarity and is obtained are shown by the degree type, respectively, when time amount until

TW and lamp voltage reach the pulse width of a time amount signal from initial voltage to the last electrical potential difference is set to TR.
[0022] Straight polarity Vsp=(Vrp2-Vrp1) xTW/TR+Vrp1 -- (several 1)
Negative polarity Vsp=(Vrn2-Vrn1) xTW/TR+Vrn1 -- (several 2)
Thus, the sampling electrical potential difference Vsp is offset voltage. (Vrp1, Vrn1) It is shown by the sum with the video signal which changed pulse width TW into the electrical potential difference. The offset voltage of this sampling electrical potential difference Vsp and the conversion gain of a video signal are controlled by the initial voltage Vrp1 and Vrn1 and the last electrical potential differences Vrp2 and Vrn2 of lamp voltage.
[0023] These luminance signals Vd1-VdM and the difference of the electrical potential difference VCOM of a common electrode are impressed to a liquid crystal device. the electrical potential difference VCOM of this common electrode -- the initial voltage Vrp and Vrn of lamp voltage -- it sets up in the middle mostly. Consequently, as shown in drawing 1 , the applied voltage VLC (1 1) of the liquid crystal of an one-line one train reverses a polarity for every frame.
[0024] The example of a property of a liquid crystal device is shown in drawing 3 . The light transmittance of a liquid crystal device changes with applied voltage, as shown in drawing. When this property is approximated in a straight line, permeability calls threshold voltage VTH and the applied voltage of 100% of permeability saturation voltage VST for the applied voltage which is 0%. This threshold voltage and saturation voltage are changed at manufacture dispersion or temperature.
[0025] In this invention, since the initial voltage and the last electrical potential difference of lamp voltage are easily controllable by the control circuit, when initial voltage and the last electrical potential difference control, the following effectiveness is acquired.
[0026] (1) The multi-tone display which displays the image of high quality with an easy configuration is realizable by setting up the initial voltage and the last electrical potential difference of lamp voltage according to manufacture dispersion of the threshold and saturation voltage of a liquid crystal device.
[0027] (2) The multi-tone display which amends the brightness fluctuation and the color gap of a display image by liquid crystal panel temperature, and displays the image of high quality by controlling the initial voltage and the last electrical potential difference of lamp voltage to compensate for temperature fluctuation of the threshold and saturation voltage of a liquid crystal device is realizable.
[0028] (3) By controlling the initial voltage and the last electrical potential difference of lamp voltage by timing of a scanning circuit, since reduction of the liquid crystal applied voltage by the voltage effect generated in the signal wiring section inside a display panel can be amended, even if highly minute, a multi-tone display with the small brightness fluctuation in a display panel is realizable.
[0029] Below, drawing 4 explains one example of the lamp voltage generating circuit of this invention. Drawing 4 consists of the lamp voltage generating circuit 51 of straight polarity, the lamp voltage generating circuit 52 of negative polarity, and the timing control circuit 53. Since the basic configuration of these two lamp voltage generating circuits is the same, it explains centering on the lamp voltage generating circuit 51 of straight polarity below. The lamp voltage generating circuit 51 consists of a phase comparator 510, the charge pump 520, an integrator 530, the electrical-potential-difference current repeater 540, a capacitor Cp2, an MOS switch 560, buffer amplifier 570, and a comparator 580. Here, the charge pumps 520 are the P-channel MOS transistor MP 1 and the N-channel MOS transistor MP 2, integrators 530 are an operational amplifier Ap1 and integrating-capacitor CP1, and the current potential transducer 540 consists of an operational amplifier Ap2, P-channel MOS transistor MP3, and resistance Rp1.
[0030] The initial voltage Vrp1 of lamp voltage is connected to the MOS switch 560 through the buffer amplifier 570. It connects with a comparator and the last electrical potential difference Vrp2 is compared with lamp voltage Vrp. Moreover, a timing signal CKV is connected to the gate of the MOS switch 560, and STP is connected to the input of a phase comparator 510.
[0031] The timing control circuit 53 is a delay circuit for inputting a timing signal CKV and setting up the time amount of lamp voltage.
[0032] The timing chart of drawing 5 explains actuation of the lamp voltage generating circuit of this invention constituted as mentioned above.
[0033] The timing signal CKV is the same as the timing signal shown in drawing 2 , and is used as timing which sets up the initial voltage Vrp1 of lamp voltage here. Moreover, timing signal STP is a

signal which sets up the time amount of the last electrical potential difference of lamp voltage, and is generated in the timing control circuit. The MOS switch 560 will be in an OFF state, and lamp voltage Vrp will change on a fixed inclination, if the MOS switch 560 will be in an ON state, initial voltage Vrp1 will be outputted, if CKV becomes "H", and CKV is set to "L."

[0034] A comparator 580 compares lamp voltage Vrn with the last electrical potential difference Vrp2, and outputs the comparison signal Dp. The comparison signal Dp serves as "H", when lamp voltage Vrn becomes larger than the last electrical potential difference Vrp2.

[0035] A phase comparator 510 detects this comparison signal Dp and the time difference of the standup timing of timing signal STP, and outputs the phase outputs Qp1 and Qp2.

[0036] One phase output Qp1 of this phase comparator is set to "L" when timing signal STP is early, and it makes an ON state the P-channel MOS transistor of the charge pump 520. At this time, the output voltage of an integrator 530 falls and the electrical potential difference V1 impressed to the resistance Rp1 of the electrical-potential-difference current repeater 540 increases. Consequently, the inclination of lamp voltage increases and advances timing of the comparison signal Dp.

[0037] On the other hand, other phase outputs Qp2 of a phase comparator serve as "H", when the comparison signal Dp is early, and they make an ON state the N-channel MOS transistor MP 2 of the charge pump 520. At this time, the output voltage of an integrator 530 goes up and the electrical potential difference V1 impressed to the resistance Rp1 of the electrical-potential-difference current repeater 540 decreases. Consequently, the inclinations of lamp voltage decrease in number and delay the timing of the comparison signal Dp.

[0038] Thus, since the negative feedback control of the lamp voltage of this circuit is carried out so that it may become equal to the standup of STP about the timing to which initial-voltage lamp voltage becomes equal to the last electrical potential difference Vrp2, it can make the electrical potential difference at the standup time of timing signal STP equal to the last electrical potential difference Vrp2.

[0039] As mentioned above, the lamp voltage generating circuit of this invention can control initial voltage and the last electrical potential difference by the electrical potential difference inputted from the exterior easily.

[0040] In addition, it is the configuration of the electrical-potential-difference current repeater 540 that the lamp voltage generating circuit 52 of negative polarity differs from the lamp voltage generating circuit 51 of straight polarity. By negative polarity, the N-channel MOS transistor is used to the thing of straight polarity consisting of P-channel MOS transistors.

[0041]

[Effect of the Invention] According to this invention, since the initial voltage and the last electrical potential difference of lamp voltage are easily controllable, the threshold of a liquid crystal device and the fluctuation of saturation voltage by manufacture dispersion or temperature are amended, and the multi-tone display which can display the image of high quality can be realized.

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[Translation done.]

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DRAWINGS

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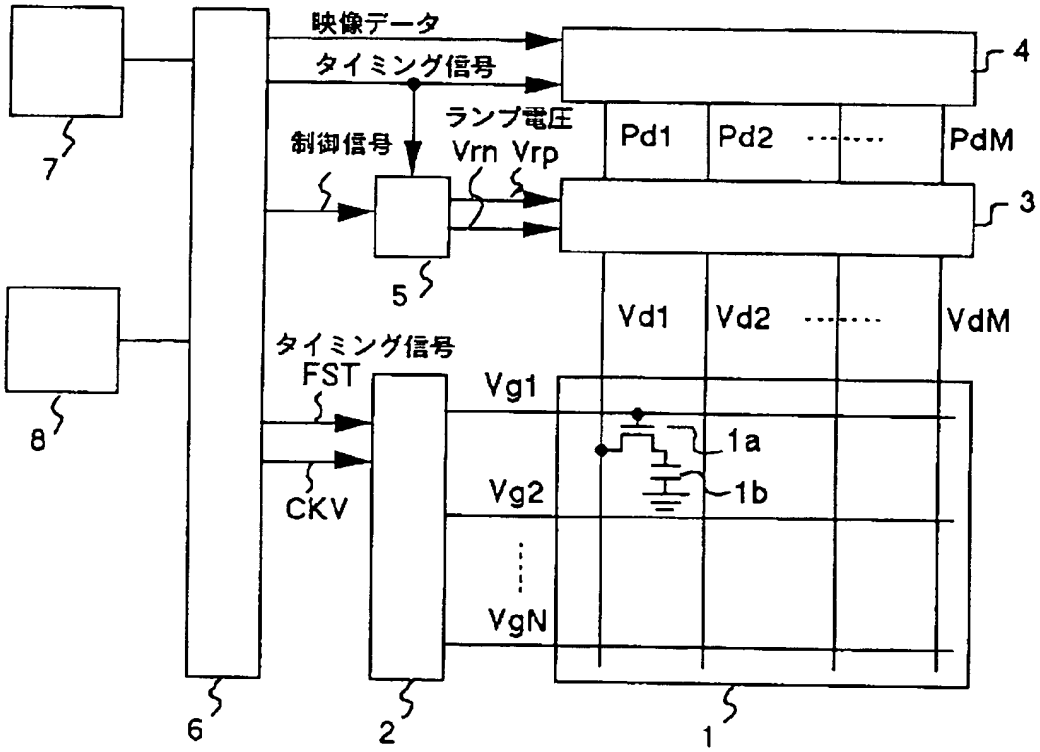
[Drawing 1]

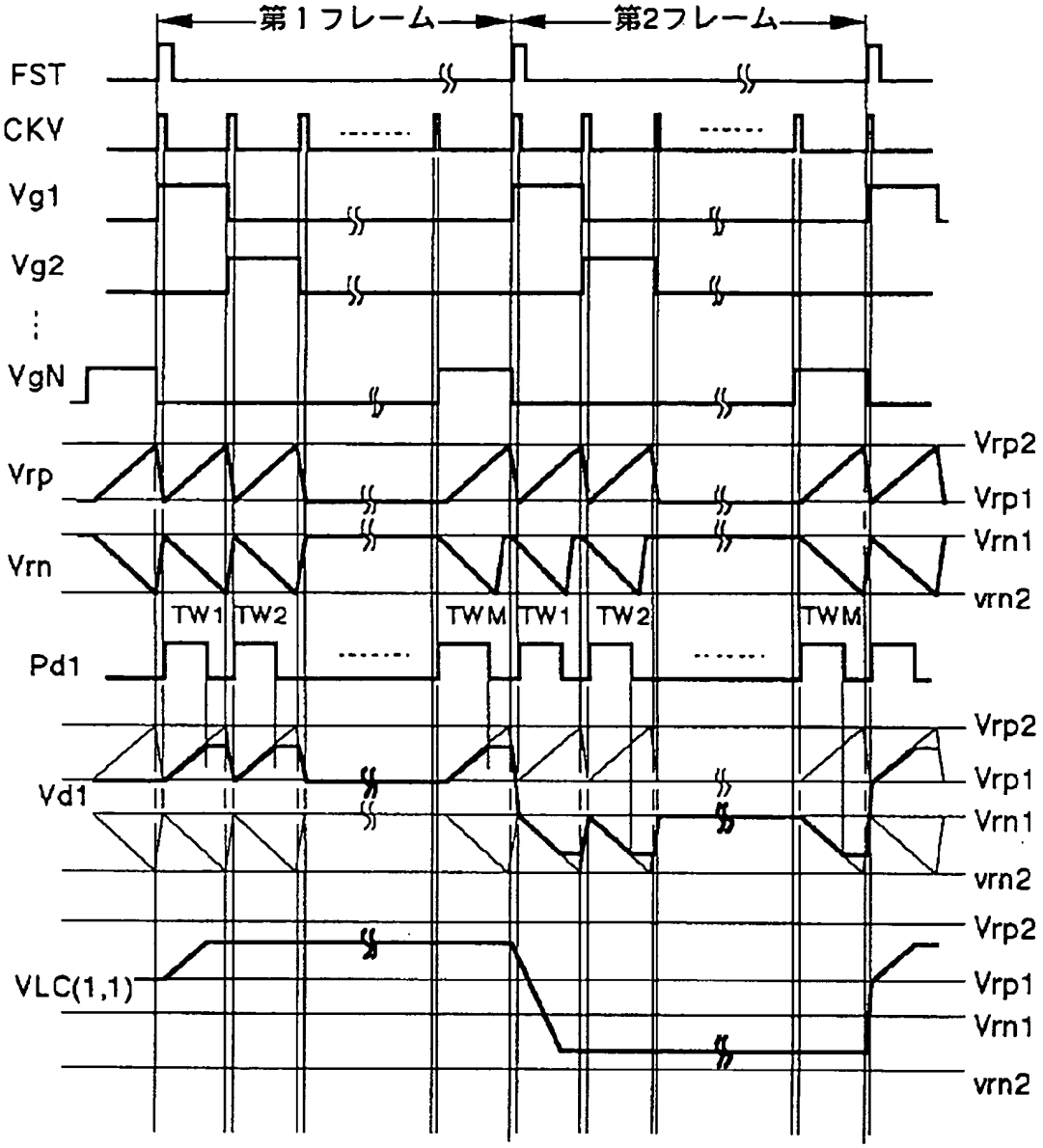
図 1




1 …液晶パネル
1 a …トランジスタ
1 b …液晶
2 …走査回路
3 …サンプリング回路
4 …サンプリング制御回路
5 …ランプ電圧発生回路
6 …コントロール回路
7 …フレームメモリ
8 …ビデオ回路

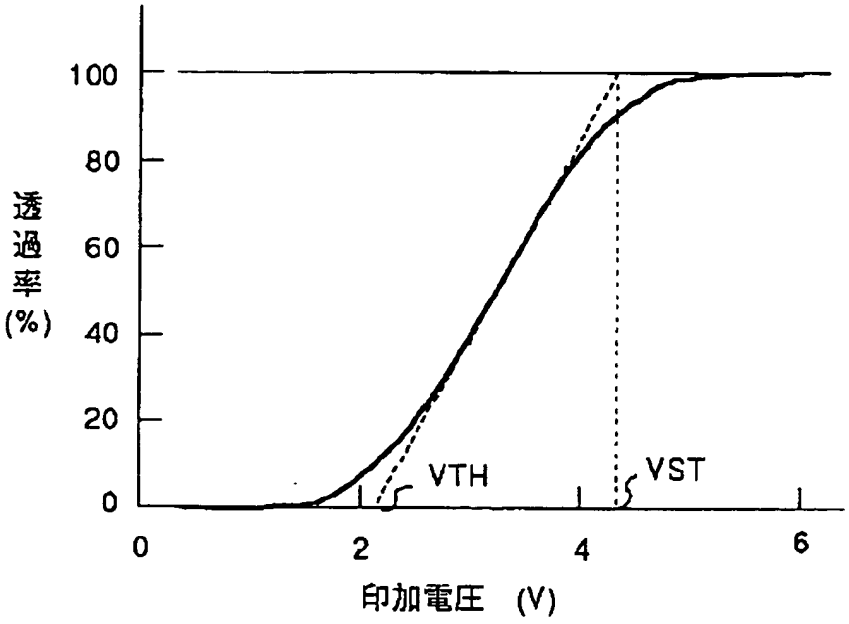
[Drawing 2]

図 2


第1フレーム
第2フレーム
FST
CKV
Vg1
Vg2
VgN
Vrp
Vrn
TW1
TW2
TWM
Pd1
Vd1
VLC(1,1)
Vrp2
Vrp1
Vrn1
vrn2

[Drawing 3]

図 3




[Drawing 5]

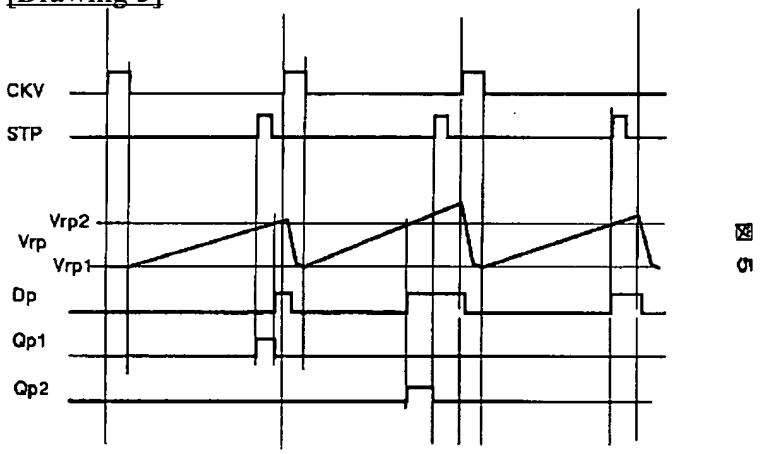
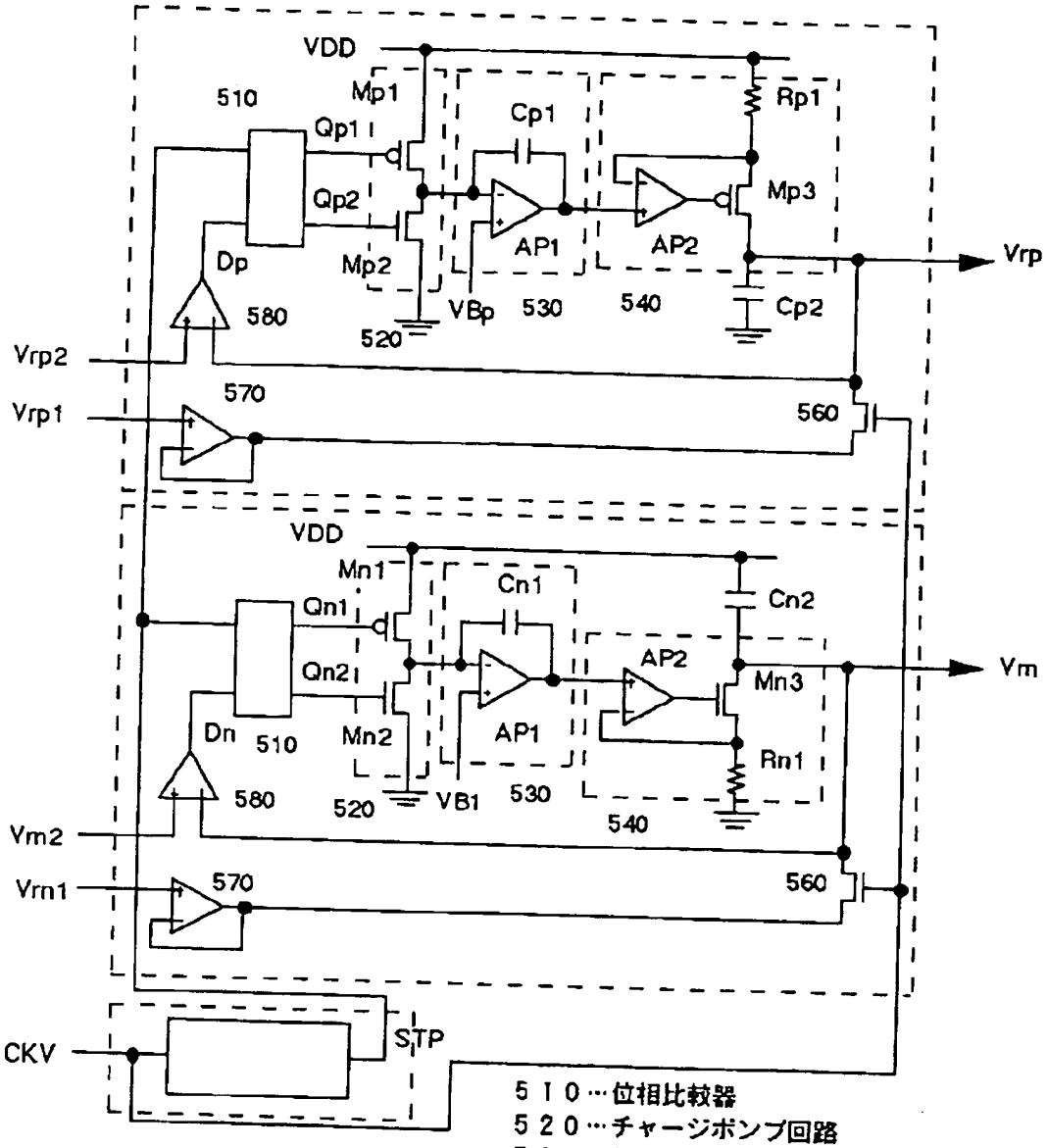



図 5

[Drawing 4]

図 4




5 1 …正極性のランプ電圧発生回路
5 2 …負極性のランプ電圧発生回路
5 3 …タイミング発生回路

5 1 0 …位相比較器
5 2 0 …チャージポンプ回路
5 3 0 …積分回路
5 4 0 …電圧電流変換回路
Cp2 …コンデンサ
5 6 0 …ＭＯＳスイッチ
5 7 0 …バッファアンプ
5 8 0 …コンパレータ

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